

The Return Of A Classic To Fuel Production

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Because of the decreasing availability of oil, interest has been renewed world-wide in the production of liquid hydrocarbons from carbon monoxide and hydrogen using metal catalysts, also known as Fischer-Tropsch Synthesis.

Ninety years ago as well as today, the Max Planck Institute of Coal Research has been at the centre of scientific experimentation in the field of catalytic chemical reactions. On the 15th of December, a colloquium will look back at the trailblazing new procedure invented by Franz Fischer and Hans Tropsch eight decades ago.

The location is the main lecture hall of the Max Planck Institute for Coal Research, Lembkestrasse 5, in the city of Mulheim an der Ruhr, Germany, the birthplace of Fischer-Tropsch Synthesis.

At 4 pm, Professor Manfred Rasch, a historian and head of the archive at the German industrial company ThyssenKrupp AG in Duisburg, will lecture on the topic "The Discovery of Fischer-Tropsch Synthesis and its Consequences for the Kaiser Wilhelm Institute of Coal Research". Then, Dr Matthijs Senden, head of research at Shell Global Solutions International BV in Amsterdam, will discuss current applications of the procedure in "Gas to Liquids: Fischer-Tropsch at work for a New Industry".

In 1925, Professor Franz Fischer, founding director of the Kaiser-Wilhelm Institute of Coal Research in Mulheim an der Ruhr, and his head of department, Dr Hans Tropsch, applied for a patent describing a process to produce liquid hydrocarbons from carbon monoxide gas and hydrogen using metal catalysts. The hydrocarbons synthesised in the process are made primarily of liquid alkanes, also known as paraffins. Other by-products are olefins, alcohols, and solid paraffins (waxes).

The required gas mixture of carbon monoxide and hydrogen -the so called synthesis gas - is created through a reaction of coke or coal with water steam and oxygen, at temperatures over 900 degrees Celsius. In the past, town gas and gas for lamps were a carbon monoxide-hydrogen mixture, made by gasifying coke in gas works. In the 1970s it was replaced with imported natural gas (methane). Coal gasification and Fischer-Tropsch hydrocarbon synthesis together bring about a two-stage sequence of reactions which allows the production of liquid fuels like diesel and petrol out of the solid combustible coal.

The second, direct method of liquifying coal was invented a few years before Fischer-Tropsch Synthesis, in 1913 in Hanover by Friedrich Bergius. Coal hydrogenation, now called coal liquefaction, involves converting coal into an oil that, like crude oil, can be processed in refineries to make petrol. The Bergius process, however, can only be performed with brown coal and "geologically young" black coal, called highly-volatile. For indirect coal liquefaction, Fischer-Tropsch Synthesis can be used on all types of coal as well as other raw materials which contain coal.



Professor Franz Fischer (left) and Dr Hans Tropsch, the inventors of a process to create liquid hydrocarbons from carbon monoxide gas and hydrogen using metal catalysts. Image: Max Planck Institute of Coal Research.

Fischer-Tropsch Synthesis took its first serious place in industry in 1935 at Ruhrchemie in Oberhausen, now the Ruhrchemie site of the Celanese AG chemical company. By the beginning of the 1940s, some 600,000 tonnes of liquid hydrocarbons were produced per year in German facilities, made from coal using Fischer-Tropsch Synthesis.

Licensed by Ruhrchemie, four facilities in Japan, as well as a plant in France and in Manchuria, were in service. After World War II, competition from crude oil made petrol production from coal unprofitable. The only new production facilities were in South Africa, for political reasons, built starting in 1950 in Sasolburg. Currently, the two plants operated by Sason Synfuels fulfil about 28 percent of South Africa's diesel and petrol needs, processing 45 million tonnes of coal per year.

Synthesis gas can also be created from natural gas - and this is less costly than from coal. Since 1993, Shell in Malaysia (Bintulu) and PetroSA in South Africa (Mossel Bay) have been operating industrial Fischer-Tropsch Synthesis facilities, which produce liquid fuels from synthesis gas which comes originally from natural gas (Gas To Liquid, GTL). A third similar plant is being built by Sasol and Qatar Petroleum in Qatar in the Persian Gulf. Last year nine more GTL-facilities were being planned world-wide; most of them are to use Fischer-Tropsch Synthesis.

For a number of years, institutions in Germany have been developing processes to create liquid fuels from biomass (Biomass to Liquid, BTL). Among those institutions are the Forschungszentrum Karlsruhe, the Clausthal University of Technology, and Choren Industries GmbH, Future Energy GmbH, and a university in Freiburg. Fischer-Tropsch Synthesis is used in all these technologies. The synthesis gas is produced from wood, straw, and other raw materials of plant origin.

Given the quick rise in the price of crude oil - and the dramatic consequences of this year's hurricane season for American oil production and processing - the US is rethinking how it deals with its large domestic coal inventory. In 2006 the first US coal-to-diesel production facility is planned in Gilberton, Pennsylvania.

It will use indirect coal liquefaction (Coal To Liquid, CTL), via coal gasification and Fischer-Tropsch Synthesis. Two further similar US projects are in discussion. China, too, has been investing recently in CTL technology using indirect Fischer-Tropsch Synthesis. Already in 2002 it began planning a commercial coal liquefaction (coal hydrogenation) facility in Inner Mongolia.[EC]

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